



City of Santa Barbara

Storm Water BMP Guidance Manual

June 2008
(Final)

Table of Contents

1	INTRODUCTION	1-1
1.1	Purpose of the Manual	1-1
1.2	Background	1-4
1.2.1	Storm Water Management & LID Concepts	1-4
1.2.2	Benefits of Storm Water Management.....	1-5
1.2.3	Federal and State Storm water Regulations	1-6
1.2.4	Storm Water Management Plan/Program Requirements (Local Storm Water Regulations).....	1-7
1.2.5	Local/Regional Coordination & Communication	1-7
1.3	City of Santa Barbara Post-Construction Storm Water Management Requirements (as defined in the SWMP)	1-8
1.4	Project Tiers	1-9
1.4.1	Requirements by Tier.....	1-9
1.5	How to Use This Manual.....	1-12
2	SITE ASSESSMENT AND BMP SELECTION	2-1
2.1	Assessing Site Conditions and Other Constraints	2-1
3	Site Soil and Infiltration Assessment	3-1
4	SITE DESIGN BMP OPTIONS	4-1
4.1	Introduction	4-1
4.1.1	Goals and Objectives	4-1
4.2	Conserve and Restore Natural Areas	4-2
4.3	Maintain, Restore and Utilize Natural Flow Paths.....	4-3
4.5	Minimize Soil Disturbance and Compaction	4-4
4.7	Disconnect Impervious Surfaces and Utilize Pervious Areas	4-8
4.8	Site Design Examples	4-9
4.8.1	Single-Family Residential.....	4-10
4.8.2	Multi-Family Residential	4-12
4.8.3	Commercial Development	4-14
4.8.4	Office Building	4-16
4.8.5	Residential Street	4-18
5	BASIC BMP OPTIONS.....	5-1
5.1	How to Choose Basic BMPs.....	5-1
5.2	Site Assessment.....	5-2
5.2.1	Soil Assessment.....	5-2
5.2.2	Site Slope Assessment	5-4
5.2.3	Roof Area Assessment	5-6
5.3	Disconnect Downspouts	5-9
5.4	Flow Spreading	5-13
5.5	Rainwater Gardens	5-15
5.6	Rain Barrels.....	5-20
5.7	Contained Planters.....	5-23
5.8	Depression Storage	5-25
5.9	Permeable Pavement for Single-Family Residences	5-27
5.10	Soil Amendments.....	5-29

5.11	Ribbon Driveways	5-31
5.12	Landscaping Considerations.....	5-33
6	STORMWATER RUNOFF BMP OPTIONS.....	6-1
6.1	General Considerations	6-1
6.2	Stormwater Runoff Requirements For BMP Sizing	6-1
6.2.1	Peak Runoff Discharge Rate Requirement	6-2
6.2.2	Volume Reduction Requirement.....	6-2
6.2.3	Water Quality Treatment Requirements	6-2
6.2.4	Meeting Stormwater Runoff Requirements Simultaneously	6-3
6.3	BMP Selection Process	6-3
6.4	Waivers For Storm Water Runoff BMP Requirements	6-4
6.5	Suggested Strategies For Meeting The Storm Water Runoff Requirements	6-8
6.6	Biofiltration And Filtration BMPs.....	6-10
6.6.1	Bioretention	6-10
6.6.2	Vegetated Swale Filter	6-31
6.6.3	Vegetated Filter Strip	6-56
6.6.4	Sand Filter	6-70
6.7	Infiltration BMPs.....	6-86
6.8	Permeable Pavement BMPs	6-107
6.9	Building BMPs.....	6-125
6.9.1	Cistern/Rain barrel.....	6-125
6.9.2	Planter Box	6-129
6.9.3	Green Roof	6-143
6.10	Retention And Detention BMPs	6-150
6.10.1	Constructed Treatment Wetland.....	6-150
6.10.2	Wet Retention Basins	6-168
6.10.3	Dry Extended Detention Basins	6-190
6.11	Proprietary Devices.....	6-215
7	REFERENCES.....	7-1
Appendix A	Glossary Of Terms	A-1
Appendix B	Site Conditions Maps.....	B-1
Appendix C	BMP Sizing Methodologies	C-1
Appendix D	BMP Design Examples	D-1
Appendix E	Basin Outlet Sizing Examples	E-1
Appendix F	Flow Splitter Design Specifications	F-1
Appendix G	Local Plant List	G-1
Appendix H	Facility Inspection And Maintenance Checklists	H-1
Appendix I	Example Agreements, Forms, And Letters.....	I-1
Appendix J	List Of Discretionary Projects Exempt From Tier 3 Requirements.....	J-1
Appendix K	DART SWMP Checklist	K-1

List of Tables

Table 1-1: Post-Construction Project Tiers	1-11
Table 2-1: Typical Site Assessment Information	2-1
Table 2-2: Pollutants of Concern Based on Land Use	2-3
Table 2-3: 303(d) Listed (2006) Water Bodies and Associated Pollutants	2-5
Table 5-1: Matrix Table for Comparison of Basic BMP Options.....	5-2
Table 5-2: Sizing factors for Rainwater Gardens (<i>modified from Bannerman, 2003</i>).....	5-17
Table 5-3: Soil Amendments and Their Specifications	5-29
Table 5-4: Landscaping Plants and Associated Local Costs	5-34
Table 6-1: BMP Selection Matrix – Pollutants of Concern.....	6-5
Table 6-2: BMP Selection Matrix - Site Suitability.....	6-6
Table 6-3: Volume Reduction & Treatment Effectiveness for Bioretention Areas	6-11
Table 6-4: Site Suitability Considerations for Bioretention Areas	6-12
Table 6-5: Applicability of Bioretention Areas for Special Design Districts	6-13
Table 6-6: Bioretention Area Design Criteria	6-14
Table 6-7: Bioretention Maintenance Quick Guide	6-28
Table 6-8: Routine Maintenance – Bioretention	6-29
Table 6-9: Major Maintenance – Bioretention	6-30
Table 6-10: Volume Reduction & Treatment Effectiveness for Vegetated Swale Filters.....	6-33
Table 6-11: Site Suitability Considerations for Vegetated Swale Filters.....	6-33
Table 6-12: Applicability of Vegetated Swale Filters for Special Design Districts.....	6-34
Table 6-13: Vegetated Swale Filter Design Criteria	6-35
Table 6-14: Vegetated Swale Filter Maintenance Quick Guide	6-52
Table 6-15: Routine Maintenance Standards - Vegetated Swale Filters	6-53
Table 6-16: Major Maintenance Standards - Vegetated Swale Filters	6-54
Table 6-17: Volume Reduction & Treatment Effectiveness for Vegetated Filter Strips.....	6-57
Table 6-18: Site Suitability Considerations for Vegetated Filter Strips.....	6-57
Table 6-19: Applicability of Vegetated Filter Strips for Special Design Districts.....	6-58
Table 6-20: Vegetated Filter Strip Design Criteria	6-59
Table 6-21: Vegetated Filter Strip Maintenance Quick Guide	6-67
Table 6-22: Routine Maintenance – Vegetated Filter Strips	6-68
Table 6-23: Major Maintenance – Vegetated Filter Strips	6-69
Table 6-24: Volume Reduction & Treatment Effectiveness for Sand Filters	6-72
Table 6-25: Site Suitability Considerations for Sand Filters	6-72
Table 6-26: Applicability of Sand Filters for Special Design Districts	6-72
Table 6-27: Sand Filter Design Criteria	6-74
Table 6-28: Sand Filter Maintenance Quick Guide.....	6-83
Table 6-29: Routine Maintenance – Sand Filters.....	6-84
Table 6-30: Major Maintenance – Sand Filters.....	6-85
Table 6-31: Volume Reduction & Treatment Effectiveness for Infiltration BMPs	6-87
Table 6-32: Site Suitability Considerations for Infiltration BMPs	6-88
Table 6-33: Applicability of Infiltration BMPs for Special Design Districts	6-88
Table 6-34: Infiltration BMP Design Criteria	6-90
Table 6-35: Infiltration BMP Maintenance Quick Guide.....	6-104
Table 6-36: Routine Maintenance – Infiltration BMPs.....	6-105

Table 6-37: Major Maintenance – Infiltration BMPs.....	6-106
Table 6-38: Volume Reduction & Treatment Effectiveness for Permeable Pavement	6-109
Table 6-39: Site Suitability Considerations for Permeable Pavement	6-110
Table 6-40: Applicability of Permeable Pavement for Special Design Districts	6-110
Table 6-41: Permeable Pavement Design Criteria	6-112
Table 6-42: Permeable Pavement Maintenance Quick Guide	6-122
Table 6-43: Routine Maintenance – Permeable Pavement.....	6-122
Table 6-44: Major Maintenance – Permeable Pavement.....	6-124
Table 6-45: Site Suitability Considerations for Cisterns.....	6-126
Table 6-46: Applicability of Cisterns for Special Design Districts	6-126
Table 6-47: Cistern Maintenance Quick Guide	6-128
Table 6-48: Site Suitability Considerations for Planter Boxes	6-130
Table 6-49: Applicability of Planter Boxes for Special Design Districts	6-130
Table 6-50: Planter Box Design Criteria	6-131
Table 6-51: Planter Box Maintenance Quick Guide.....	6-140
Table 6-52: Routine Maintenance – Planter Boxes	6-140
Table 6-53: Major Maintenance – Planter boxes	6-142
Table 6-54: Site Suitability Considerations for Green Roofs	6-144
Table 6-55: Applicability of Planter Boxes for Special Design Districts	6-144
Table 6-56: Green Roof Design Criteria.....	6-145
Table 6-57: Green Roofs Maintenance Quick Guide	6-149
Table 6-58: Volume Reduction & Treatment Effectiveness for Treatment Wetland	6-152
Table 6-59: Site Suitability Considerations for Treatment Wetlands	6-153
Table 6-60: Applicability of Treatment Wetlands for Special Design Districts	6-153
Table 6-61: Treatment Wetland Design Criteria	6-154
Table 6-62: Treatment Wetland Maintenance Quick Guide	6-164
Table 6-63: Routine Maintenance Standards – Treatment Wetlands	6-165
Table 6-64: Major Maintenance Standards – Treatment Wetlands	6-166
Table 6-65: Volume Reduction & Treatment Effectiveness for Wet Retention Basins.....	6-170
Table 6-66: Site Suitability Considerations for Wet Retention Basins	6-170
Table 6-67: Applicability of Wet Retention Basins for Special Design Districts	6-171
Table 6-68: Wet Retention Basin Design Criteria	6-172
Table 6-69: Wet Retention Basin Maintenance Quick Guide.....	6-186
Table 6-70: Routine Maintenance Standards – Wet Retention Basin	6-187
Table 6-71: Major Maintenance Standards – Wet Retention Basin	6-188
Table 6-72: Volume Reduction & Treatment Effectiveness for Dry ED Basins	6-191
Table 6-73: Site Suitability Considerations for Dry Extended Detention Basins.....	6-192
Table 6-74: Applicability of Dry ED Basins for Special Design Districts.....	6-192
Table 6-75: Dry Extended Detention Basin Design Criteria	6-194
Table 6-76: Dry Extended Detention Basin Maintenance Quick Guide	6-211
Table 6-77: Routine Maintenance Standards - Extended Detention Basins	6-212
Table 6-78: Major Maintenance Standards - Extended Detention Basins	6-213
Table 6-79: Proprietary Device Manufacturer Websites	6-221

List of Figures

Figure 1-1: Manual Flowchart Based on Project Tier	1-3
Figure 3-1: Post-fill Soil Profile	3-2
Figure 4-1: Example of Soil Disturbance Minimization	4-4
Figure 4-2: Example of Minimizing Impervious Surfaces by Implementing Bioretention in a Parking Lot	4-5
Figure 4-3: Example of Minimizing Impervious Surfaces in a Parking Lot.....	4-6
Figure 4-4: Disconnected Downspout Directed to a Pervious Area	4-8
Figure 4-5: Single-Family Site Design Example.....	4-11
Figure 4-6: Multi-Family Residential Site Design Example.....	4-13
Figure 4-7: Commercial Site Design Example	4-15
Figure 4-8: Office Building Site Design Example	4-17
Figure 4-9: Residential Street Design Example	4-18
Figure 5-1: Example of disconnected downspout that directs runoff to pervious area	5-9
Figure 5-2: Flow Spreading - Directing Runoff from a Disconnected Downspout Away From a Foundation (University of California, Santa Barbara).....	5-13
Figure 5-3: Rainwater Garden Implemented in the Front Yard of a Single-Family Santa Barbara Residence	5-15
Figure 5-4: Rain Barrel Blends Into Surroundings	5-20
Figure 5-5: Contained Planters With Trees and Flowers	5-23
Figure 5-6: Depression Storage.....	5-25
Figure 5-7: Typical Permeable Pavement Cross-Section	5-27
Figure 5-8: Permeable Pavers in a Driveway in Front of a Single-Family Residence in Santa Barbara.	5-27
Figure 5-9: Grass Paver Blocks in a Residential Driveway.....	5-28
Figure 5-10: Gravelpave ²	5-28
Figure 5-11: Soil amended area at U.S. EPA Ariel Rios Building	5-29
Figure 5-12: Ribbon Driveway	5-31
Figure 5-13: Ribbon Driveway	5-31
Figure 5-14: Local Landscaping	5-33
Figure 6-1: Bioretention Area – Arroyo Burro	6-10
Figure 6-2: Bioretention Area Schematic.....	6-26
Figure 6-3: Roadside Swale	6-31
Figure 6-4: Trapezoidal Channel Capacity Chart	6-40
Figure 6-5: Vegetated Swale Filter Schematic	6-49
Figure 6-6: Flow Spreader and Check Dam Schematics.....	6-50
Figure 6-7: Vegetated Filter Strip Providing Pretreatment for a Bioretention Area	6-56
Figure 6-8: Vegetated Filter Strip Schematic	6-65
Figure 6-9: Volleyball Court Sand Filter	6-70
Figure 6-10: Sand Filter Schematic	6-82
Figure 6-11: Infiltration Basin	6-86
Figure 6-12: Infiltration Basin Schematic	6-99
Figure 6-13: Infiltration Trench Schematic	6-100
Figure 6-14: Dry Well Schematic	6-101
Figure 6-15: Permeable Pavers	6-107

Figure 6-16: Permeable Pavement Schematic.....	6-120
Figure 6-17: Typical Above Ground Cistern	6-125
Figure 6-18: Planter Box	6-129
Figure 6-19: Planter Box Schematic.....	6-138
Figure 6-20: Typical Cross Section of a Green Roof	6-143
Figure 6-21: Constructed Treatment Wetland at University of California, Santa Barbara.....	6-150
Figure 6-22: Constructed Treatment Wetland Schematic.....	6-162
Figure 6-23: Wet Retention Basin with Vegetation Along Perimeter	6-168
Figure 6-24: Wet Retention Basin Schematic.....	6-182
Figure 6-25: Riser Outlet Schematic – Option 1	6-183
Figure 6-26: Inverted Pipe Outlet Schematic – Option 2	6-184
Figure 6-27: Dry ED Basin (dual use; playing field when dry).....	6-190
Figure 6-28: Dry Extended Detention Basin Schematic.....	6-204
Figure 6-29: Perforated Riser Outlet Schematic – Option 1	6-205
Figure 6-30: Perforated Riser Outlet Schematic – Option 2	6-206
Figure 6-31: Multiple Orifice Outlet Schematic – Option 3	6-207
Figure 6-32: Emergency Spillway Schematic	6-208
Figure 6-33: Filterra Tree Box Filter.....	6-215

Appendix A	Glossary Of Terms	A-1
Appendix B	Site Conditions Maps.....	B-1
Appendix C	BMP Sizing Methodologies	C-1
Appendix D	BMP Design Examples	D-1
Appendix E	Basin Outlet Sizing Examples.....	E-1
Appendix F	Flow Splitter Design Specifications	F-1
Appendix G	Local Plant List	G-1
Appendix H	Facility Inspection And Maintenance Checklists	I-1
Appendix I	Example Agreements, Forms, And Letters.....	J-1
Appendix J	List Of Discretionary Projects Exempt From Tier 3 Requirements.....	K-1
Appendix K	DART SWMP Checklist	L-1